higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

BUILDING SCIENCE N2

3 APRIL 2018

This marking guideline consists of 7 pages.

QUESTION 1

1.1 1.1.1 The relative density/specific gravity of material is the density of that material compared with the density of water or the mass of any volume of a material✓ compared with the mass of an equal volume of water.✓ (2)

1.1.2 Capillary action/attraction is the manifestation of surface tension by which the portion of the surface of a liquid✓ coming in contact with a solid is elevated or depressed,✓ depending on the adhesive or cohesive properties of the liquid.✓ (3)

1.1.3 Heat cannot be created or lost.✓ It can however be transferred from one substance to another.✓ Heat will always flow from a hot substance to a cold substance.✓ This concept is known as propagation of heat. (3)

1.1.4 Heat capacity is the measurable physical quantity that characterises the amount of heat required to change the temperature of a body by a given amount.✓
In SI units, heat capacity is expressed in units of joules per kelvin.✓
The heat capacity of a body is the quantity of energy required to raise the temperature of that body by 1°C.✓ (3)

1.2 A hydrometer is used to measure✓ the density/specific gravity of a liquid.✓ (2)

1.3 1.3.1
- High resistance to puncture
- Easy to apply
- Self-healing
- Not too expensive
- Waterproof
- The material will not expand at high temperatures and will not crack at low temperatures. (Any 2 × 1)

1.3.2
- Mixture of well-graded sand and Portland cement
- Manufacture in various profiles
- Tough
- Durable
- Inflammable (Any 2 × 1)

(2 × 2) (4)

[17]

QUESTION 2

2.1 Uniformly distributed load (1)

2.2 The moment of a force is the turning effect (energy)✓ that is caused by the force✓ about its axis of rotation.✓ (3)

2.3 2.3.1 Take moments about R_R to calculate the magnitude of R_L.

$\sum$ CW Moments = $\sum$ ACW Moments
$R_L \times 7,5) = (40 \times 3 \times 6) + (60 \times 4) + (30 \times 4 \times 2)$✓
$(R_L \times 7,5) = 720 + 240 + 240$✓
$R_L = \frac{1\ 200}{7,5}$✓
$R_L = 160$ kN✓✓ (5)

2.3.2 Take moments about R_L to calculate the magnitude of R_R.

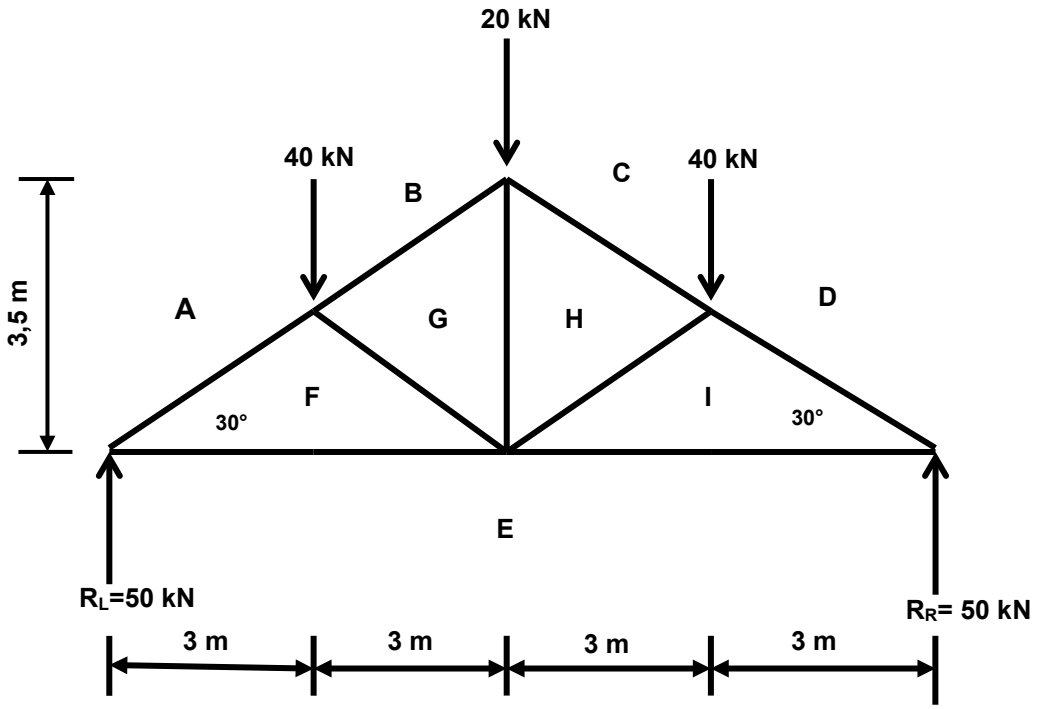
ACW Moments = $\sum$ CW Moments
$(R_R \times 7,5) = (30 \times 4 \times 5,5) + (60 \times 3,5) + (40 \times 3 \times 1,5)$
$(R_R \times 7,5) = 660 + 210 + 180$✓
$R_R = \frac{1\ 050}{7,5}$✓
$R_R = 140$ kN✓✓ (5)

2.3.3 Test the answer to prove the equilibrium:

$\sum$ Upwards forces = $\sum$ Downwards forces
(160 kN + 140 kN) = (120 kN + 60 kN + 120 kN)✓
300 kN = 300 kN ✓ (2)
[16]

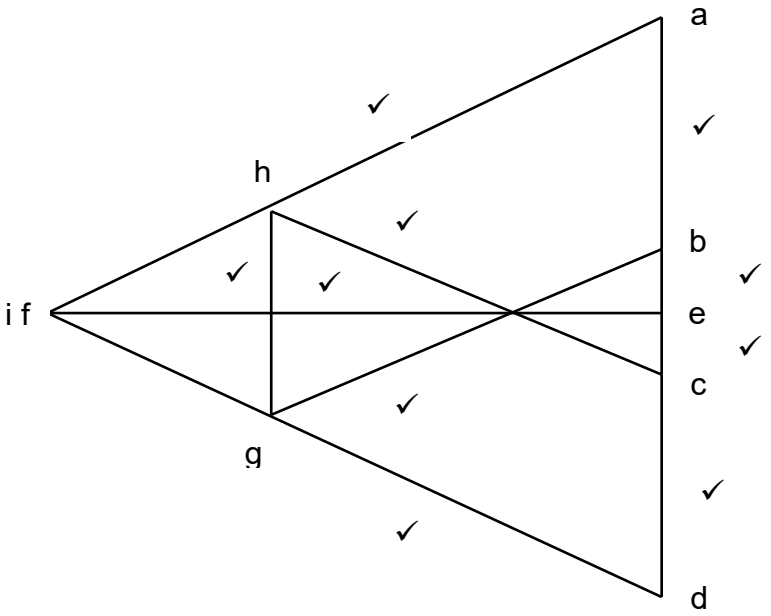
QUESTION 3

3.1



(2)

3.2



(10 × ½) (5)

3.3

MEMBER	MAGNITUDE	NATURE
AF	100 kN✓	Strut✓
BG	60 kN✓	Strut✓
CH	60 kN✓	Strut✓
DI	100 kN✓	Strut✓
EF	86 kN✓	Tie✓
EI	86 kN✓	Tie✓
FG	39 kN✓	Strut✓
GH	39 kN✓	Tie✓
HI	39 kN✓	Strut✓

(18 × ½) (9)
[16]

QUESTION 4

MEMBER	AREA	LEVER ARM DISTANCE	AREA × DISTANCE
1	60 × 60 = 3 600 mm^2	30 mm✓	3 600 mm^2 × 30 mm = 108 000 mm^3✓
2	½ × 30 × 35 = 525 mm^2	11,67 mm✓	525 mm^2 × 11,67 mm = 6 126 mm^3✓
3	20 x 15 = -300 mm^2	37,5 mm✓	300 mm^2 × 37,5 mm = -11 250 mm^3✓
TOTALS	**= 3 825 mm^2 ✓✓**		**= 102 877 mm^3 ✓✓**

$$\bar{y} = \frac{\text{(Total area} \times \text{Distance)}}{\text{Total area}}$$

$$\bar{y} = \frac{102\ 877\ mm^3}{3\ 825\ mm^2}\checkmark$$

$\bar{y}$ = 26,896 mm from A-B on the Y-Y axis✓✓

[13]

QUESTION 5

5.1 5.1.1 The resultant is a single force which can replace two or more forces working on a body✓ and produce the same effect as those forces.✓

5.1.2 The equilibrant is that single force which keeps two or more forces✓ working on a point in equilibrium.✓

(2 × 2) (4)

5.2

FORCE			VERTICAL COMPONENT (F X SIN θ)			HORIZONTAL COMPONENT (F X COS θ)		
AB	40	0°	0			E	+	40
BC	30	45°	S	-	21,213	E	+	21,213
CD	45	30°	S	-	22,500	W	-	38,971
DE	60	60°	N	+	51,961	W	-	30
			N	**+**	**8,248** ✓✓	**W**	**-**	**7, 697**✓✓

$R^2 = VC^2 + HC^2$

$R = \sqrt{(8{,}248)2 + (7{,}697)}2$✓

R = **11,282 kN**✓✓

$$\tan\theta = \frac{\sum VC}{\sum HC}$$

$$\tan\theta = \frac{8.248}{7.697}$$ ✓

$$\theta = \tan^{-1} 1{,}072$$✓

= **46,979°**✓✓

Resultant = 11,282 kN✓ @ 46 979°✓ north of west✓ (14)
[18]

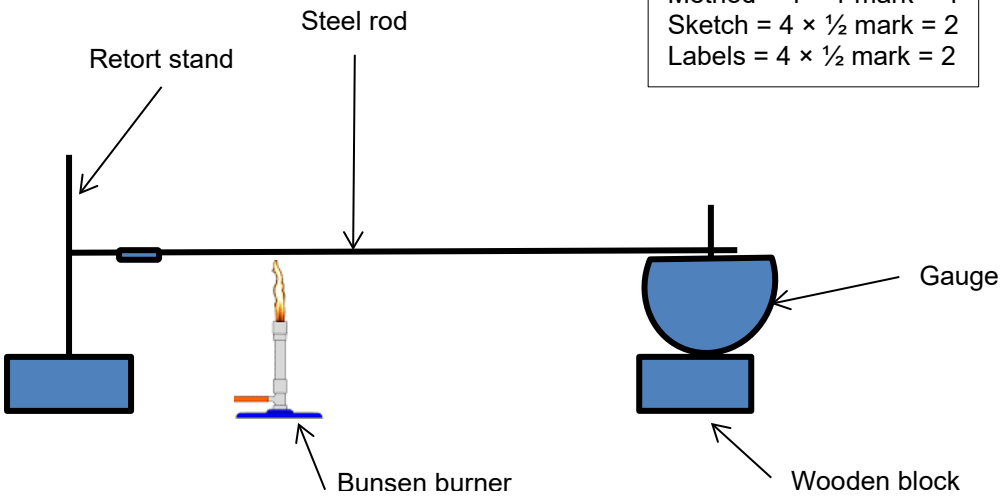
QUESTION 6

6.1 Apparatus
- Retort stand
- Metal/steel rod
- Bunsen burner
- Needle and gauge
- Wooden block

Method
- Clamp the rod in stand and fix rod and gauge on wooden block as shown in the sketch.
- Heat the rod.

Observation
- The movement in the rod's edge will cause the gauge to show a reading.

Conclusion
- The rod increased in length due to the increase in temperature.



Method = 4 × 1 mark = 4
Sketch = 4 × ½ mark = 2
Labels = 4 × ½ mark = 2

(8)

6.2 Heat x loss = Heat x loss

M x s.h.c x Δt = M x s.h.c x Δt

3 x 4 200 x (70 – t_2) = 5 x 4 200 x (t_2 – 30)✓✓

882 000 – 12 600t_2 = 21 000t_2 – 630 000

882 000 + 630 000 = 21 000t_2 + 12 600t_2✓

1 512 000 = 33 600t_2

$t_2 = \frac{1\,512\,000}{33\,600}$✓

t_2 = **45 °C**✓✓ (6)

6.3 $\Delta L = Lo\ x\ \Delta T\ x\ \alpha$

= 600 x (145 – 18) x 20 x 10^{-6}✓

= 600 x 127 x 20 x 10^{-6}

= 1,524 mm ✓✓

L_{Final} = Lo + Lu

L_{Final} = 600 + 1,524✓

L_{Final} = 601,524 mm✓✓

(6)
[20]

TOTAL: 100